Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Part 15 Regarding New	)	**ET Docket No. 04-37**
Requirements and Measurement Guidelines	)	
For Access Broadband over Power Line	)	**NPRM 04-29**
Systems	)	

Via the ECFS

Reply In Support On Comments of Joseph A. Huie of 4 April 2004
by Leonard H. Anderson

I wish to thank the Commission for providing a forum for commentary by all citizens. Please allow me to state that I am a retired electronics design engineer with no vested interest in any professional or amateur radio activity or educational institution nor with any of those who have commented on this petition or Rule Making. All of the following comments are those of a private citizen fortunate to experience a half century in the radio-electronics industry and military of the United States, that including radio communications..

Mr. Huie has made cogent comments on incidental Radio Frequency (RF) radiation limits in good engineering practice, devoid of some perceived hysteria of several commenters on the title docket.[1] I will add to Mr. Huie's findings and explanations plus an alternate measurement relative to my Comment filed on 9 March 2004.

A. Holding To A Low Level Standard For Incidental RF Radiation

1. There has been **no** detailed technical information on Access BPL installed test systems' actual line levels.[2] With that, no one can possibly comment accurately on any specific incidental RF radiation levels to be expected. At best, we can only conjecture on possibilities, choosing an arbitrary base point. In that, Mr. Huie brings forth representative data from the Standard Time and Frequency stations WWV and WWVH operated by NIST (National Institute on Science and Technology) and

[1] Mr. Huie's filing, obtained from the ECFS, is included entire as an Appendix here.

[2] This includes the controlled-circulation (free) electronics industry periodicals such as *EDN, Electronic Design, E.E. Times, RF Design, Microwaves & RF,* nor membership periodicals such as *Spectrum* by the IEEE (Institute for Electrical and Electronic Engineering).

comparisons to random noise from atmospherics and galactic noise sources. That, in turn, is compared to a selected electric field intensity, specified for general devices given in Part 15 for the High Frequency (HF) spectrum. The referenced antenna is the same in all comparisons.

2. The referenced antenna is not indicative of any specific HF receiving antenna simply because the types of such antennas are **not** typical, varying widely in an urban environment.

3. The environment and location of the referenced antenna is urban. That will apply to over 90 percent of all expected Access BPL installations.[3] Such areas are coincidentally those having the greater number of HF and VHF (Very High Frequency) receivers which, in turn, will be affected by Access BPL incidental RF radiation.[4]

4. Commissioners have all expressed great enthusiasm about Access BPL benefitting *rural* citizens.[5] While that is certainly laudable effort, the reality is that rural users which would benefit the most is a decided minority of the population, less than 10 percent.

5. Even if Access BPL were to serve **only** rural areas over existing electric power lines, the origin or *head end* of an Access BPL provider can be reasonably expected to be located in an urban area. That would result in the electric power lines becoming a **miles long** quasi-*Beverage* antenna capable of radiating BPL signals from each and every discontinuity and wired repeater installation

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[3] The economics of any broadband service provider as an operating business will drive service regions to an area of greatest revenue potential. This will be the urban and suburban residential areas with many subscribers per unit area; only large apartment and condominium zones have a greater revenue potential per unit area than conventional residence areas.

[4] The largest definitive group of HF-VHF receiver equipped potential interference-receiving victims are Amateur Radio operators. As of 1218 UTC, 6 April 2004, *hamdata* website (www.hamdata.com) figures, taken from the Commission's database, indicate a total of 727,145 licensees, exclusive of club licenses. The number of Citizens Band users can only be grossly approximated at somewhere between a half million to a million in or very near urban areas. Citizens Band Radio Service operates on 40 frequency channels at an approximate center of 27 MHz. There is no license required by *CB* as Citizens Band Radio Service is familiarly called but regulations on use are included in Part 95, Title 47 C.F.R. There is a somewhat popular activity of listening to so-called *shortwave* broadcasting, several specific broadcast bands in the HF spectrum with broadcasting stations located in nearly all nations. The number of *SWLers* as such listeners sometimes call themselves is unknown but might be a quarter million in a very gross approximation. There are no immediately-available sales figures on such receivers other than they continue to be consumer electronics products of several varieties on the market such as in the *Best Buy* and *Fry's Electronics* store chains. All of the large Amateur Radio transceiver makers have specific model receivers for HF broadcast reception. *Grundig* makes several portable HF broadcast receivers, notable for their *Yacht Boy* models manufactured for over two decades. *Scanner* listeners, similar to HF broadcast listeners, will be affected by the low-VHF RF radiation in the 30 to 50 MHz region. *Scanning* is done primarily in urban areas to monitor local government and business agency transmissions. Again, there is no definitive data on the number of *Scanner* listeners since the United States does not license anyone to receive radio signals. A gross total of all not in the military or government sector who might be affected directly by incidental RF radiation from Access BPL might be 2 to 3 million.

[5] NPRM 04-29 attachments, pages 34 to 38.

along its entire length.[6] Such an electric power line would be located part-way in urban areas.

6. Urban areas will have electric power distribution lines stretching over a mile in all directions from an electric power central station. That is a gigantic horizontal *curtain* antenna, size unprecedented in the relatively short (108 year) existence of radio as a communications medium.[7]

7. Since **no** electric power transmission line in the United States has ever been designed or constructed as any sort of HF-VHF **transmission line**, attempts to use existing electric power lines as such will have unknown, impossible-to-predict effects on the HF-VHF environment.[8] Every single line discontinuity, every subscriber *drop* connection, every line circuit breaker or protection device, every BPL coupler, every BPL wired repeater are all potential RF re-radiators of the BPL signal. Since the BPL signals are pseudo-random *noise* they will add in RF power from **every** specific point of RF radiation along the electric power line.

8. There is **no** possibility of predicting the effect of additive RF noise from incidental RF radiation from an Access BPL installation. The existing electric power grid, not designed for the purpose of RF transmission line characteristics, is too variable for such prediction. Incidental RF radiation **must** be measured at **many locations** along such an installation.

9. Since each and every urban or rural electric power distribution grid varies, and that electric power lines are **not** designed as RF transmission lines, there is no predictability possible on the exact number of measurement locations. It is not practically possible to measure every Access BPL subscriber or potential-subscriber location in any one system. That would amount to **millions of locations** in the United States to do random, spot-sampling at selected frequencies. The Commission's budget would be stretched enormously beyond present figures. Yet, the potential for incidental RF radiation **over a broad RF spectrum** is the spectre of possibility to millions of citizens.

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[6] The *Beverage* antenna, named for its originator, was simply a very long elevated horizontal single wire used principally at MF and lower prior to 1930. Despite a large search of available information, there is no data on a Beverage antenna longer than a half mile. Rural electric power lines may reach 10 to 40 miles in length to the first rural user concentration.

[7] The term *curtain* is a generic one, usually referred to as multiple elements located in a single plane. In practical use, curtain antennas are erected in a vertical plane using wire elements and supports between two poles or towers. A *Sterba Curtain* is typical in MF and HF use with many references in older antenna literature of multiple dipoles strung between two poles, dipoles having tree-like feed sections. Horizontal-plane curtain antennas are rare, closest approximations being single vertical conductor structures with the top extended by multiple wires in horizontal-plane directions. Very Low Frequency (VLF) stations used by the United States Navy to alert submerged submarines are approximately in the curtain antenna category.

[8] Electric power transmission lines are designed to work efficiently at 60 Hz and slightly higher to account for a few harmonics of the basic alternating current sinewave. Access BPL systems are proposed to operate over the majority of the higher HF spectrum and lower VHF spectrum, roughly 60,000 to 1,200,000 times higher than the 60 Hz power frequency. That is like imagining residence door bell wiring will work fine as a TV antenna lead-in for a few meters. In reality it may do that, inefficiently, but there is no predictability of efficacy.

10. Mr. Huie's tabulations check out as correct in comparison to the present incidental RF radiation levels in Part 15 and the Standard Frequency reception in mid-Illinois and the atmospheric and galactic noise textbook levels. Part 15 incidental RF radiation levels **cannot be increased for the sake of any Access BPL system or provider in the future.**

11. If anything, the Part 15 incidental RF radiation levels **should be lowered** at least 6 db more. Pseudo-random noise powers are **additive** and the quite-probable-many such noise sources simply contribute to the local broadband noise environment.

12. Some reasonable incidental RF radiation limits **must** be reached **and enforced** lest the Commission would disenfranchise millions of the citizenry and make the HF to low-VHF spectrum a **vast wasteland of RF noise pollution.**[9]

B. An Alternative Measurement Method For Broadband Radiation Measurement

13. Access BPL is not only broadband for conducted digital data, it is also broadband for pseudo-random noise in incidental RF radiation. There is no prediction capability for the intensity of such radiation at any one frequency for any given location. Initial system measurement and repeated checks need to be performed at many different frequencies within the broad bandwidth.

14. The National Telecommunications and Information Agency (NTIA) has made wideband surveys at several locations in the United States since 1995 using automated, very broadband, recording monitoring systems mounted in a mid-sized van vehicle.[10] While continuous logging and totalizing of wideband spectral energy does not appear to be required, the wideband receiving systems serve as a system model of what can be utilized.

15. Since electric power lines are mainly located parallel to streets and roads, a broadband monitoring receiver in a van can travel relatively slowly along such roadways with many specific frequencies monitored automatically along the route. The automatic monitoring can signal operators if an Access BPL radiated signal level rises above a preset, preprogrammed level. Such a system permits monitoring of nearly the entire electrical distribution wire routing with minimal time and

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[9] Former Commissioner Newton Minnow made the *vast wasteland* term either famous or infamous in his speech to the National Association of Broadcasters on 9 May 1961, 43 years ago. Commissioner Minnow was then speaking of television program content. The possible effects of Access BPL noise pollution in urban areas is much more severe, in effect rendering it unuseable to anything but very local, high power communications. The HF to low VHF spectrum is prized because it can utilize ionospheric effects to reach around the globe to all other nations. To overpower each possible receiving site with deliberate noise pollution - just to enhance a single service provider - is a true disenfranchisement of the citizenry, the creation of an unwanted **spectral wasteland.**

[10] One such method is detailed in the NTIA survey of the Los Angeles, CA, area in NTIA Report 97-336. Similar surveys have been done and reported for cities of San Diego, CA, Denver, CO, and San Francisco, CA. A listing of NTIA Reports is found at http://its.bldrdoc.gov/pub/pubs.html#pg1.

expense. Should the automated system indicate a level exceeding limits, operators can stop the vehicle and perform manual, on-site measurements.

C. Consideration Of Distance From Electric Power Lines In Residential Areas

16. The expectation of greatest number of incidental RF radiation interference cases will be in urban, residential areas. That is where most of the amateur radio operators, CB operators, SW BC and Scanner listeners are located. A house residence is typically one-quarter to one-third acre in size. If a house lot is taken as a square plan, the length of one side would then be 104.36 to 120.50 feet.[11]

17. Given that most electric power distribution lines are located at the street edge, overhead or underground, the back side of the one-quarter to one-third acre lot would be 31.81 to 36.73 meters away on the same horizontal plane. It would be unrealistic to use a measurement distance of 30 meters. It is unrealistic to assume all HF to low-VHF antennas are mounted at a farthest distance from electric power lines. Overhead or aerial electric power lines may vary in elevation from about 20 to 30 feet or 6.1 to 9.1 meters. That is a typical elevation range and varies from community to community. A more realistic distance would be 15 meters slant range equivalent.

D. Consideration Of Access BPL Incidental Radiation In Comparison To Natural Noise

18. Mr. Huie has a very realistic statement in *"The issue of what BPL interference limits to establish at 30 meters distance from power lines is difficult; however, it seems to me that allowing BPL noise to exceed atmospheric noise by more than 40 db continuously round the clock for all seasons of the year, is an untenable position for the Commission."* I agree wholeheartedly with that statement.

19. Natural noise such as thermal, atmospheric, galactic, and such are all *random*. As such all random noise sources **add in power**. Data on a broadband Access BPL system will be the equivalent of a non-coherent or *pseudo-random* basis for any small segment of the total Access BPL signal bandwidth. Pseudo-random noise power will **add** to all other noise sources.[12] For any supposed Access BPL system that will include a BPL subscriber *drop* and its coupler to the electric power lines, the electric power lines themselves including all discontinuities due to splices and wire

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[11] Standard area of one acre is 43,560 square feet. House lots can vary considerably in dimension ratios so a square plot is assumed for estimation purposes.

[12] Pseudo-random noise generation has been employed in civil engineering for at least three decades to test the vibration and shock characteristics of building structures, in communications engineering to simulate bandwidth-controllable natural noise sources. Pseudo-random noise generation is also used in cryptography in the form of *maximal length sequences* using cascaded digital shift register chains with controlled state feedback. The Hewlett-Packard 3722A Noise Generator of 1968 is a good example of such a bandwidth-controllable pseudo-random noise source; the instruction manual for same is also a good primer on such sources and their use.

spacing changes, any Access BPL wired repeater amplifiers along that electric power distribution network.[13]

20. The entirety of the Access BPL system must be considered as a multiple-source noise generator. There can be no rational comparison to a small unit such as *a carrier-current telephone extension* that is supposed to utilize internal building electric power wiring for two-way telephone communications, replacing physical wiring.[14] That is beside the point of no test-installation Access BPL system publishing any technical data on their signal levels, signal power budget figures in the local vicinity of a subscriber, or even system details.

21. Each and every subscriber **and** their non-subscribing neighbors are potential interference claimants of HF to low-VHF incidental radiation noise interference from a local Access BPL system. That could number a hundred thousand in a medium-sized city. Such radiation noise receiving victims are not limited to radio amateurs and can include HF broadcast listeners, Scanner listeners, CB radio users, plus business, government and military HF to low-VHF radio installations.

22. It would be prudent of the Commission to plan ahead for a sufficient number of incidental RF radiation measurement locations in **each** planned Access BPL system installation. Each and every such system will be unique to the community, no two are alike anymore than any two electric power distribution systems are alike. Such a number of measurement locations is dependent on the Commission's consideration of what constitutes a system operating under the Part 15 incidental RF radiation level limits at any time. The Commission will be charged with investigation of radio interference complaints.

E. On The Improbability of Access BPL Bandspace *Notched* To Reduce Interference

23. Some Access BPL proponents claim that tailoring of the characteristics of their digital modulation system can be done so as to reduce spectral content in certain portions or bands of their signal's total bandspace or *notching*. This is supposed to reduce interference in amateur radio bands on the basis of complaints of interference from radio amateurs. I submit that is a **practical impossibility.**

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[13] The term *repeater* is used in the telephony sense; e.g., as a two-way amplifier and equalizer to overcome normal line attenuation and changes due to frequency and phase response of the transmission line. It is does not connote the radio sense where a *repeater* is a combination receiver and re-transmitter, each tuned to different frequencies.

[14] An example is the *Phonex Telephone Extension Jack* [equivalent] sold through the *Lowes* home maintenance chain for about US$90 the pair in 2002. That model family fails to negotiate the internal *split-phase* distribution from the power line *drop* such to form two separated electric power wiring distribution chains. While that may work in unshielded electric wiring (of the *Romex* variety or equivalent), it does not work well in metallic box and conduit enclosures which are made to earth ground.

22. Tailoring the digital modulation of any broadband system such as to reduce spectral content in certain frequency locations is technically possible, but primarily only in harmonically-related frequency locations in the spectrum. Amateur Radio allocated bands in the HF to low-VHF spectrum are no longer all harmonically-related as can be seen in §97.301.[15] Amateur Radio operators are not the sole possible victim of incidental RF radiation from Access BPL systems.

23. *Shortwave Broadcast Listeners* or *SWLs* in the colloquial term will be equally affected by HF noise from BPL. From the very large tabulation in §2.106 for the United States as of 1 October 2003 there are **10 separate** HF broadcasting bands with a total spectrum occupancy of 4,175 KHz.[16] There is no good accounting of how many *SWLs* are in the United States but there are a few regional listener clubs. Some radio amateurs are also *SWLs* and vice-versa. International HF broadcasting is alive and well, still practiced around the clock and around the world.

24. Citizens Band Radio Service, or *CB* in the colloquial term is confined to 40 fixed carrier frequencies beginning just below 27 MHz.[17] Since CB is not a licensed radio service, the actual number of CB users could be any number from tens of thousands to a million or more, nationally. A large percentage of CB users are mainly in the trucking and hauling business, their communications activity taking place on highways, thruways, freeways and Interstates.[18] As such they would be remote from Access BPL systems installed in urban areas. However, if Access BPL systems actually extend to rural areas, those users would be susceptible to incidental RF radiation noise on any route that took them along electric power distribution lines.

25. *Scanner* listening enthusiasts are a niche group using semi-automatic tuning receivers or *scanners* that have varying frequency ranges but usually from 30 MHz and up. Those are informal recreational radio users but do include members of public safety agencies that use their receivers for information on alerts and potential situations in their community. Since no receivers in the United

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[15] Since at least 1956, United States Amateur Radio HF band allocations have been *80, 40, 20, 15,* and *10* meter wavelengths; operating frequencies are essentially harmonically related and probably so located to ease the design of *all-band* radio amateur equipment of that time. Since then, particularly as a result of the World Administrative Radio Conference of 1979, new bands at *30, 17,* and *12* meters were added which are not so harmonically related. The 5 channels recently allocated at about *60 meters* do not fall into the harmonic relation. The amateur *160* meter band frequencies fit the harmonic relation but are in MF or Medium Frequency and below any Access BPL bandwidth values given by the Commission.

[16] There is a 50 KHz overlap of shared use at the upper end of the amateur 40 meter band for broadcasting according to §2.106. However, informal monitoring indicates such broadcasting use on the amateur 40 meter band is from foreign broadcasters, not those in the United States. All other broadcasting and amateur bands in the HF spectrum are separate and distinct.

[17] Part 95, Title 47 C.F.R.

[18] CB radio transceivers are low-power, compact, with relatively short antennas, easily installed in vehicles. Complete CB transceiver packages, including antenna, are sold for US$100 in chain department stores such as *K-Mart* and *Target*. First authorized in 1958 on the so-called *11 meter* band, CB has grown and developed its own patois and jargon, that widespread enough to be used in recordings, motion pictures, and on television.

States require any licensing, the number of *scanner* listeners is unknown. *Sacnning* receivers remain a consumer electronics product in the market.

26. Radio Control or *R/C* of model aircraft, vehicles, and boats is a reasonably-large recreational and avocational group of the citizenry. Radio Control of model aircraft is the largest activity among the members of the Academy of Model Aeronautics (AMA), a 170,000 member organization headquartered in Muncie, Indiana.[19] While Amateur Radio frequencies may be used according to §97.215, the greatest R/C activity uses the unlicenced 80 fixed carrier frequencies in the 72 to 76 MHz band given in Subpart B of Part 95, Title 47 C.F.R.[20] All radio control activity is low power and generally line-of-sight to the aircraft, therefore susceptible to higher-power RF interference.[21] The popular unlicensed 72-to-76 MHz band is near the top of reported Access BPL bandwidth.

27. Standard Time and Frequency stations WWV and WWVH operate on multiples of 5 MHz up to 25 MHz, all allocated small, protected band segments exclusive of others. If those frequencies are interfered with, then the citizenry lose a valuable time and frequency reference provided by the National Institute of Science and Technology.

28. Given that there are 26 separate and distinct frequency bands in the HF to 76 MHz VHF portion of the Electromagnetic spectrum, very few of them harmonically related, it seems highly unlikely that any Access BPL digital data modulation scheme can effectively *notch* all of them. Some bands, all already in use by various citizens, will still be there and with the potential for interference from incidental RF radiation from Access BPL.

E. The Improbability of So-Called *Quiet Time* For An Access BPL Provider

29. Mr. Huie states on his page 4, *"The Commission's requiring a shut-down feature in the BPL system is very good. It is further proposed that each BPL system be shut down completely for 6 hours each week. This could be Monday morning local time from 12:01 AM to 6:00 AM."* I submit that such a shut-down is both improbable and unlikely given the nature of data being carried on the Access BPL system.

30. American citizens do not all work *day* jobs with early evening for recreation and late evening to morning for sleep. The United States is active 24 hours a day, its citizens working many

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[19] AMA website is http://www.modelaircraft.org/templates/ama/.

[20] While 6 carrier frequencies in the 11 meter band are allocated (former *Class C Citizens Band of many years ago),* those are seldom used due to the interference from the CB radio voice users.

[21] A private club organization recently completed a solo R/C model flight from Nova Scotia to Ireland, only the take-off and landing operated by manual radio control. GPS receiver coupled to a guidance electronics package did the navigation over most of the trans-Atlantic flight.

different *shifts* of time around the clock. While midnight to 6 AM is the sleep period for most Americans it is not necessarily true for all the various communications service providers in this nation. Most communications providers in the United States pride themselves on continuity of their operations around the clock, 24 hours a day. This includes the Internet Service Providers or ISPs.

31. *Quiet time* on existing Internet service providers is rare and most such times are given in advance, such a time needed for the provider's own maintenance purposes. The Internet is not subject to diurnal sleep cycles. Internet operations are largely automated.

32. Economic factors can limit a protracted , almost daily *quiet time* schedule. As with American broadcasting and periodicals, the Internet provider's major income source is advertising sales. Access BPL systems will be run as businesses, not avocational activities such as Amateur Radio.

33. If there are true, investigated incidental RF radiation conditions with any Access BPL system, then the only choice is to force such systems to cease operation after a notified time limit. While that is a draconian action, no Access BPL system deserves freedom of polluting the HF to low-VHF spectrum with noise.

F. Choice Of Short Whip Or Loop Antenna For Measurements Below 30 MHz

34. I disagree with Mr. Huie's comment on that subject. On his page 5 he states, *Note: the active whip permits the possibility of mobile measurements following power lines over large distances. The magnetic loop exhibits directional qualities that likely would preclude mobile operation."* True, an electromagnetic loop does have a bidirectional property, rotating that loop by a half turn is a very easy way to determine a maximum signal strength.

35. To follow electric power lines, a mobile loop need only be rotated so that its plane is perpendicular to the direction of those power lines. If that loop is fixed in position while performing mobile measurements while in motion, maximum signal will be indicated by the vehicle's position along a roadway.

36. An electrically-short whip antenna **without a counterpoise**, as with human-carry measurement procedures will have directional characteristics depending on the walking surface ground or ground-equivalent characteristics. This is especially true in the elevation of the antenna pattern. It can also vary due to its carried angular error to true vertical.

37. An electromagnetic loop has rather uniform signal strength characteristics in any direction in the plane of the loop structure..

Summary

While Access BPL systems have a seeming potential for communications good in the future, they also have an unknown potential to be very bad for existing HF and low-VHF band users and general citizenry. Mr. Huie's remarks and comparisons to natural noise sources are in good engineering practice. I have expanded on some of Mr. Huie's findings and indicated more detail on those HF to low-VHF users in the civilian population who will be the most affected by incidental RF radiation from Access BPL. In utilizing electric power lines as transmissions lines for broadband data transmission, there is new ground broken in engineering practices in creating an unprecedented, huge antenna that has the capability to interfere with others over the many square miles of its installation. There is no precedent for the utilization of existing lines which were never designed for wideband RF transmission. Except for those privy to an individual Access BPL system details, all of us are in the dark as to what we can calculate or expect.

I thank the Commission for allowing an independent citizen's viewpoint to be heard and with the ability to share a half century's accumulation of experience and knowledge in radio and electronics towards proposed rulemaking.

Respectfully submitted this 7th day of April, 2004,

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Comments In Response to Notice of Proposed Rule Making: FCC 04-29

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April 4, 2004

In the Matter of

Carrier Current Systems, including Broadband over Power Line Systems	**ET Docket No. 03-104**
Amendment of Part 15 regarding new requirements and measurement guidelines for Access Broadband over Power Line Systems.	**ET Docket No. 04-37**

1. Definition of Access BPL (see page 14 of the NPRM)

The definition should be revised to be:

"Access Broadband over power line (Access BPL): A carrier current system that transmits radio frequency energy by conduction over electric power lines owned, operated, or controlled by an electric service provider. The electric power lines may be aerial (overhead) or underground. The system is designed such that the signals are received by conduction directly from connection to the electric power lines. The lines are unintentional radiators. All necessary steps are taken to minimize radiation."

The proposed amendment to Section 15.3 by adding paragraph (ff) should be changed accordingly.

It is important that Access BPL be clearly understood to operate only by conduction and not by radiation.

2. Access BPL Emission Limits (see page 15, paragraph 33. "…we are proposing to subject Access BPL operations to the existing Part 15 radiated emission limits for carrier current systems…."

This should be modified such that the radiation limits in the frequency range 1.705 to 30 MHz are changed from 30 microvolts/meter at 30 meters to:

Frequency MHz	BPL Electric Field at 30 meters in uV/m	Measurement bandwidth in kHz
1.705 MHz	17.6 uV/m	3 kHz
3	10	3
10	3	3
30	1	3

The rationale for recommending these limits follows here.

It is well known that the limiting factor (relative to received signal to noise ratio) in the reception of HF signals is atmospheric noise. Therefore BPL limits should be established based on some relationship to expected atmospheric noise. This is especially important with BPL which is broadband in nature rather than single frequency.

Consider the reception of HF signals broadcast from Standard Frequency and Time Stations WWV and WWVH operated by the U.S. Government on frequencies: 2.5, 5, 10, 15 and 20 MHz. For illustration, reception is assumed by an electrically short whip, lossless, matched to the receiver impedance and operating over perfect ground. Receiver bandwidth is taken as 3 kHz.

Frequency MHz	BPL Received Level at 30uV/m in dBm	Atmospheric Noise (winter morning)		BPL level above noise in dB
2.5 MHz	-56.9 dBm	-120 dBm	(Fa=19 dB)	63.1 dB
5	-62.9	-116	(Fa=23 dB)	53.1 dB
10	-68.9	-108	(Fa=31 dB)	39.1 dB
15	-72.4	-109	(Fa=30 dB)	36.6 dB
20	-74.9	-117	(Fa=22 dB)	42.1 dB
30	-78.4	-121	(Fa=18 dB)	42.6 dB

Frequency MHz	BPL Received Level at 30uV/m in dBm	Atmospheric Noise (summer night)		BPL level above noise in dB
2.5 MHz	-56.9 dBm	-62 dBm	(Fa=77 dB)	5.1 dB
5	-62.9	-73	(Fa=66 dB)	10.1 dB
10	-68.9	-91	(Fa=48 dB)	22.1 dB
15	-72.4	-106	(Fa=33 dB)	33.6 dB
20	-74.9	-117	(Fa=22 dB)	42.1 dB
30	-78.4	-121	(Fa=18 dB)	42.6 dB

Noise levels were calculated based on noise measurements presented in CCIR Report 322, 1963 for the central part of the United States. Fa is the Noise factor for the frequency in question taken from the noise contours in the Report. In

accordance with standard practice the power density of the RF field times the effective aperture of the receiving antenna is the available power to the receiver.

$Pd=E^2/377$ watts/square meter
$Ar=0.75(\lambda^2/4\pi)$ meters squared (for a short whip over ground)

Received dBm= -78.4-20log(fmhz)+20log(EuV/m)

Noise levels presented are, of course, median values. Actual values vary, with the statistics presented in CCIR Report 322. As noted in the tables above, there is significant diurnal and seasonal variation at the lower end of the HF range. At 30 MHz the noise is primarily galactic noise.

One might argue that there is no such thing as a lossless short whip over a perfect ground, but that is not the issue here. The interfering noise adds, in space, with the atmospheric noise to establish the receive signal to noise ratio. The noise figure of the receiver is not significant compared with the external noise.

The issue of what BPL interference limits to establish at 30 meters distance from power lines is difficult; however, it seems to me that allowing BPL noise to exceed atmospheric noise by more than 40dB continuously round the clock for all seasons of the year, is an untenable position for the Commission. The problem is made even more difficult by the broadband nature of the noise. The received noise power increases linearly with bandwidth, which would not be the case with narrow band interference.

It is strongly recommended that special radiation limits be established for BPL under Title 47 Part 15 with the bandwidth for measurement being explicitly cited. Specifically the following limits are suggested:

Frequency MHz	BPL Electric Field at 30 meters in uV/m	Measurement bandwidth in kHz
1.705 MHz	17.6 uV/m	3 kHz
3	10	3
10	3	3
30	1	3

The Commission should also present the limits in graphical form to allow interpolation at intermediate frequencies. Measurements could be permitted with different bandwidths if the interference is broadband in nature and the results normalized to 3 kHz. Typically, HF receiver bandwidths range from 200 Hz to 6 kHz. The Commission should consider extending the above limits to 50 MHz or the highest Access BPL operating frequency.

Following is a restatement of the tabular summary of BPL interference above atmospheric noise for a winter morning considering the revised limits suggested above.

Frequency MHz	**BPL Received Level, revised, in dBm**	**Atmospheric Noise (winter morning)**	**BPL level above noise in dB**
2.5 MHz	**-64.9 dBm**	**-120 dBm(Fa=19 dB)**	**55.1 dB**
5	**-76.9**	**-116 (Fa=23 dB)**	**39.1 dB**
10	**-88.9**	**-108 (Fa=31 dB)**	**19.1 dB**
15	**-95.9**	**-109 (Fa=30 dB)**	**13.1 dB**
20	**-100.9**	**-117 (Fa=22 dB)**	**16.1 dB**
30	**-107.9**	**-121 (Fa=18 dB)**	**13.1 dB**

The Commission's proposed amendment to Section 15.109 should be recast considering the new limits cited above.

3. Access BPL Operational Requirements (see page 18, paragraph 42.)

The Commission's requiring a shut-down feature in the BPL system is very good. It is further proposed that each BPL system be shut down completely for 6 hours each week. This could be Monday morning local time from 12:01 AM to 6:00 AM. This quiet time would allow for appropriate ambient noise tests and analysis. This quiet time requirement should continue for at least 12 months after operational status for each separate BPL system (or after a major change to the system).

Existing Access BPL systems currently deployed should be brought into compliance with new standards. Six months time should be allowed.

Prior to startup of any new Access BPL system, a public announcement and disclosure of all technical details and measurements should be made available to licensed users (in the local area) of the spectrum.

Each Access BPL system operator should maintain a "Public File" listing ownership details and all technical information related to the system including a history of all measurements. The "Public File" should be locally available.

4. Access BPL Equipment Authorization and Measurement Guidelines (see page 19, paragraph 45.)

The Commission's requirement for *in situ* compliance measurements is good.

The following comments apply to APPENDIX C: PROPOSED MEASUREMENT GUILDELINES.

Under "1. <u>General Measurement</u>…" add:

8) The reference bandwidth for measurements shall be 3 kHz. If the interference is noise like in structure then a noise bandwidth in the range of 0.6 to 6 kHz may be used with results normalized to 3 kHz.

9) For frequencies below 30 MHz, an active whip less than λ/8 in length may be used as an alternate to a magnetic loop. Appropriate calibration data shall be presented to verify accuracy. As with an active magnetic loop, care should be taken to guard against overload.

Note: the active whip permits the possibility of mobile measurements following power lines over large distances. The magnetic loop exhibits directional qualities that likely would preclude mobile operation.

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April 4, 2004